

Chapter 6 Practice Problems

(P6.2) $P_r = 30, T_r = 15$

(a) Use virial equation of state.

$$Z = 1 + (B^0 + \omega B^1)P_r / T_r \dots\dots\dots \text{Eqn. 6.6}$$

$$B^0 = 0.083 - \frac{0.422}{T_r^{1.6}}$$

Where, $B^1 = 0.139 - \frac{0.172}{T_r^{4.2}} \dots\dots\dots \text{Eqns. 6.8 \& 6.9}$

$$B^1 = 0.139 - \frac{0.172}{T_r^{4.2}}$$

$$\Rightarrow B^0 = 0.077459277$$

$$\& B^1 = 0.138998$$

$$\& \omega = -0.041(\text{book})$$

$$\Rightarrow Z = 1 + (0.077459277 - 0.041 * 0.138998) * \frac{30}{15} = 1.14$$

(b) $\rho = ??$

$$T = T_r * T_C = 15 * 44.4 = 666K$$

$$P = P_r * P_C = 2.653 * 30 = 79.59MPa$$

$$Z = \frac{PV}{RT}, \Rightarrow V = \frac{Z * R * T}{P * MW} = \frac{1.14 * 8.314 * 666}{79.59 * 20.179} = 3.93cm^3 / g$$

$$\Rightarrow \rho = \frac{1}{V} = \frac{1}{3.93} = 0.254g / cm^3$$

(P6.4)

$$T_1 = 111K$$

$$P_1 = 1atm \approx 0.1MPa$$

$$T_2 = 77^\circ F = 25^\circ C = 298.15K$$

Use PREOS.XLS,

\Rightarrow

Current State		Roots		Stable Root has a lower fugacity
T (K)	111	Z	V	fugacity
P (MPa)	0.1		cm ³ /gmol	MPa
answers for three		0.9670679	8924.6249	0.096803
root region		0.0263855	243.49944	
		0.0036451	33.639114	0.093707

Use Solver, and set target cell on the volume and make it equal to

$$33.639114 * 2 = 67.278228,$$

Then by changing the cell of pressure, making sure that $T_2 = 298.15K$

Current State		Roots	
T (K)	298.15	Z	V
P (MPa)	33.839895		cm ³ /gmol

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answers for three root region	#NUM!	#NUM!
	#NUM!	#NUM!
	#NUM!	#NUM!
& for 1 root region	0.9184568	67.278228

$$\Rightarrow P_2 = 33.84 \text{ MPa}$$
